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## Short communication

# Effect of Organic Nutrients on Flower Yield and Oil Content of Chamomile (*Matricaria chamomilla* L.)

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## Abstract

Chamomile (*Matricaria chamomilla* L.) is one of the most important medicinal plants in Iran. The main objective of this study was to determine the effects of organic nutrients on the yield and oil content of chamomile. The experiment was conducted in the spring of 2010. The treatment groups consisted of vermicompost (0, 5, 10, 15 and 20 tons/ha) and the Aminol Forte sprays (no spraying or control, at the flowering stage and at budding stage). The experimental design was a factorial experiment based on Randomized Complete Block Design (RCBD) with three replications. The present results showed that the highest flower head diameter, flower yield and essential oil content were obtained when 20 ton/ha vermicompost was used. Effects of Aminol Forte were similar to those seen in vermicompost treatment and all measured traits were seen to be significant after the Aminol Forte spray at flowering stage.

**Key words**: Vermicompost, Amino acids, Aminol Forte, *Matricaria chamomilla* L., Yield.

## Introduction

Chamomile (*Matricaria chamomilla* L.) is an annual plant belonging to the Asteraceae family [1]. Chamomile is an herb, native to Iran and Europe that grows as a wild plant [2]. Chamomile is naturally widespread in the west, northwest and south of Iran and its consumption has a long history in Iranian folklore medicine [2].

Chamomile may be considered as an economic substitute of the field crops, irrigated with fresh water since it has adaptability to a wide range of soil and climatic conditions. Many medical properties of chamomile are attributed to its essential oil. Therefore, the improvement of oil quality and quantity is among the major objectives of chamomile breeding programs [3].

Sustainability of agricultural systems has become an important issue throughout the world. Many of the sustainability issues are related to the quality and time-dependent changes of the soil [4,5].

Vermicompost contains the most nutrients in plant-available forms such as nitrates, phosphates, and exchangeable calcium and soluble potassium [6]. Vermicompost has large particulate surface area that provides many microsites for the microbial activity and strong retention of nutrients. It is rich in microbial population and diversity, particularly fungi, bacteria and actinomycetes [6]. It contains plant growth regulators and other growth-influencing materials produced by microorganisms [7]. Vermicompost also contains large amounts of humic substances and some of the effects of these substances on plant growth have been shown to be very similar to those of soil-applied plant growth regulators or hormones [8].

The beneficial effects of vermicompost have been observed in horticultural [9, 10] and agronomic crops [11,12].

However, most of the researches on use of vermicompost have been carried out on the horticultural crops and a few workers have reported the use and effect of vermicompost on the field crops and medicinal plants. Studies have proved that amino

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acids can influence the physiological activities in the growth and development of plants. According to several studies, the foliar application of amino acids causes an enhancement in plant growth and fruit yield while the maintenance of protein component is also regulated in cucumber [13], garlic [14] and sweet pepper [15]. The main objective of this study was to determine the effects of organic nutrients on the yield and essential oil of chamomile.

## Materials and Methods

Location and study design

The present study was conducted during the growing season of 2010 at the Research Institute of Forests and Rangelands in Karaj. The experimental design was a factorial study, based on Randomized Complete Block Design (RCBD) with three replications. Treatments consisted vermicompost with five concentration levels (V1 = zero, V2 = 5, V3 = 10, V4 = 15 and V5 = 20 t $ha^{-1}$) and Aminol Forte spraying at three levels (F1 = control, F2 = at flowering stage, and F3 = at budding stage). Analysis of soil samples showed that pH=7.5, P=2 mg/kg, K=249 mg/kg and N = 0.02%. The amino acid treatment, used in this experiment, was Aminol Forte, which consists of several amino acids, as described in Table 1. Vermicompost was analyzed for major nutrients, as shown in Table 2.

Each experimental plot was 3 m long and 2 m wide with the total area of 6 $m^2$. Chamomile seeds were obtained from the Research Center of Medicinal Plants, Isfahan, Iran. Sowing was done manually on 20th April, and three weeks after sowing, the seedlings were thinned up to 33.3-plant $m^{-2}$ (30 × 10 cm distance). The experimental plots were irrigated weekly and the weeds were controlled manually.

Data of the plant height (cm), flower yield (kg $ha^{-1}$), and essential oil content were recorded from each treatment. Measurements and samplings were done on the inner rows in each plot, discarding 50 cm from both ends to avoid edge effects.

For all plants in each plot, several harvests were done with the interval of 7–10 days. Cumulative measurements for the number of flowers per plant and flower weights were used for the analysis. At the beginning of the flowering period, plant height was measured for each plot using a ruler (±0.1 cm) from the base to the tip of the plant. Flower diameters were measured with a vernier caliper (±0.01 cm).

Essential oil extraction

To determine the amount of essential oil, a sample of 100 g of flowers was mixed with 500 ml of tap water in a flask and the water was distilled for 3 h using a Clevenger-type apparatus. The oil content was measured by following the protocol of Letchamo and Marquard [16], based on ml oil per 100 g dry matter of flower at the Biochemistry and Biophysics laboratory of University of Tehran.

Statistical analysis

All data were subjected to the statistical analysis (one-way ANOVA) using SAS software. Comparisons of means were performed by Duncan's Multiple Range Test (DMRT) at the 5% probability level.

## Results

The results have indicated that all measured traits were significantly affected by using vermicompost and the Aminol Forte spray, except for the values of flower head diameter after the spray of amino acids (Table 3).

**Table 1** Chemical ingredients of Aminol Forte for its amino acid constitution.

| Aminogram | Distribution (%) |
|---|---|
| Glycine | 1.80 |
| Valine | 5.10 |
| Proline | 8.40 |
| Alanine | 13.21 |
| Aspartic Acid | 4.50 |
| Arginine | 8.40 |
| Glutamic Acid | 0.90 |
| Lysine | 5.10 |
| Leucine | 16.51 |
| Isoleucine | 4.50 |
| Phenylalanine | 5.10 |
| Methionine | 4.20 |
| Serine | 3.90 |
| Theronine | 3.00 |
| Histidine | 3.00 |
| Glycocoll | 9.60 |
| Tyrocine | 1.50 |
| Glutamine | 0.90 |
| Cystine | 0.30 |
| Other | 0.08 |

**Table 2** Chemical analysis of vermicompost used in the experiment.

| pH | ECe (ds/m) | Total N (%) | K (%) | P (%) | OC (%) | OM (%) | Moisture (%) | Fe (ppm) | Zn (ppm) | Mn (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 1.1 | 4.92 | 3.19 | 0.61 | 37.7 | 65 | 25 | 36-50 | 27-40 | 15-25 |

Plant height

After the application of vermicompost, the chamomile plant height was increased significantly. Results showed that by increasing the vermicompost amount from V1 to V5, the plant height increased linearly. The highest plant height (44.7 cm) was recorded by using a 20-ton vermicompost per hectare. Comparisons of means showed significant differences between the various levels of Aminol Forte spraying. Foliar application of Aminol Forte at F2, caused the plant to reach the highest height (39.6 cm). Due to their nitrogen content, amino acids are the fundamental ingredients of the protein synthesis process.

Flower head diameter

The flower head diameter was significantly influenced by vermicompost treatment. Use of the vermicompost from V1 to V4 did not cause major differences in flower head diameter (Table 3). The flower head diameter was greater (P≤ 0.05) with 20 ton ha-1 vermicompost application.

Comparisons of means have shown significant differences between the various levels of Aminol Forte treatments. Spraying the Aminol Forte at flowering stage caused increased flower head diameter. However, there were no significant differences in flower head diameter between the plants in plots sprayed with Aminol Forte.

Flower yield

Vermicompost had positive effects on the flower yield of chamomile. Plants grown on the plots, treated with V5, had a significantly greater flower yield (P≤ 0.05).

By increasing the vermicompost amounts, the flower yield increased nonlinearly. The highest fresh and dry flower yields (3335.7 and 653.8 kg/ha, respectively) were recorded at V5 treatment. The highest flower yield of chamomile under V5 might be due to higher number of flowers per plant and an increased flower head diameter (Table 3).

Comparisons of means showed significant differences between the various levels of Aminol Forte spraying. Foliar application of amino acids at F2 phase (flowering stage) caused the greatest fresh and dry flower yield (Table 3). Significant differences in flower yield were also recorded for the plants sprayed with Aminol Forte at the budding stage (F3) and control (F1).

Essential oil content

According to the results of this investigation, vermicompost and amino acids could enhance quantitative and qualitative characteristics of chamomile. especially by using 20 ton ha-1vermicompost and spraying Aminol Forte at flowering stage.

Analysis of variance showed that vermicompost and Aminol Forte had significant effects on the essential oil content. Comparisons of means showed significant differences between the various levels of vermicompost treatments (Table 3). Total essential oil content varied between 0.39 and 0.54% (Table 3), which was obtained from control (V1) and V5, respectively. There were significant differences in essential oil content between the plants sprayed with varied levels of Aminol Forte treatments. Foliar application of Aminol Forte at F2 (Flowering stage) resulted in greatest essential oil content (Table 3).

## Discussion

Vermicompost contains most of the plant nutrients including nitrate, phosphates, exchangeable calcium and soluble potassium [6], and microelements which not only result in improved plant growth and development but also increased qualitative and quantitative yield of many crops [7, 12].

**Table 3** Effects of vermicompost and Aminol Forte on some traits of chamomile (*Matricaria chamomilla* L.).

| Treatments | Height (cm) | Flower head diameter (mm) | Fresh flower yield (kg/ha) | Dry flower yield (kg/ha) | Essential oil (%) |
|---|---|---|---|---|---|
| Vermicompost (ton/ha) | | | | | |
| 0 | 24.6 c | 18.2 b | 1500.77 d | 352.95 d | 0.39 c |
| 5 | 33.8 b | 18.7 b | 2611.23 c | 492.42 c | 0.45 b |
| 10 | 36.1 b | 18.8 b | 2727.5 bc | 505.77 c | 0.48 b |
| 15 | 41.9 a | 19.5 b | 2972.54 b | 582.63 b | 0.53 a |
| 20 | 44.7 a | 22.1 a | 3335.7 a | 653.81 a | 0.54 a |
| Aminol Forte spraying | | | | | |
| No spraying (control) | 25.1 b | 18.7 a | 1454.78 c | 342.07 c | 0.41 b |
| at flowering stage | 39.6 a | 19.9 a | 2868.10 a | 562.15 a | 0.54 a |
| at budding stage | 38.2 a | 19.6 a | 2528.48 b | 505.18 b | 0.49 a |

*Mean values followed by the same letter are not significantly different at $P \leq 0.05$.

Azizi *et al.* (2009) have found the positive influence of vermicompost on the essential oil and chamazulene contents of chamomile [17]. Other studies have indicated similar results on some medicinal plants [5, 18, 19]. These findings are accordance with the previous observations on the *Fragaria ananasa* and *Foeniculum vulgare* [18, 20].

Amino acids are the fundamental ingredients of the protein synthesis process because of their nitrogen content. The importance of nitrogen or amino acids came from their increased application for the biosynthesis of a large variety of non-nitrogenous materials *i.e.* pigments, vitamins, coenzymes, purine and pyrimidine bases [15].

Many studies have reported that foliar application of amino acids caused an increase in the growth and development of plants [14,15].

## Conclusions

In conclusion, the results of current experiment show that vermicompost and amino acids or Aminol Forte have no detrimental but rather stimulatory effects on the growth, flower yield and essential oil content of chamomile and have thus considerable potential for providing nutritional elements in chamomile production, especially for the sustainable production systems.

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